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Realtime Video Tracking With Modified Lucas Canade With Optical Flow

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ABSTRACT: Tracking the objects which are moving is very challenging and interesting area of research. Detection of moving objects and tracking can be done efficiently by optical flow algorithm. Optical flow is superior to all energy difference method. This is a robust algorithm. In this particular work, two different algorithms modified from traditional lucas canade is done. One is the conventional method, in which the flow vectors for each frame has to be found out and thus tracking the moving objects in illumination changes, in shadows and in complex background is possible. To improve the accuracy, a modification to get the highest correlation in Eigen values is added to the conventional method and is implemented. This helps to reduce the computation cost and supports to track on-time videos. The comparison of both methods is done. The tracking outputs are shown with the standard state of art method which is the ground truth result for this tracking. More information about the moving target is additionally found in the modified approach and the betterness of the algorithm is proved in MATLAB outputs and tested in Standard PETS dataset.

KEY WORDS: *Flow vectors, ground truth, Lucascanade, Thresholding,Tracking,Velocity.*

1. INTRODUCTION

Video surveillance [1],[2],[3],[4],[5] is growing area of research. It is vital in achieving high degree of security in roads, shops, banks, offices and forestry. Videos recorded from CCTV or in on time needs to be tracked for variety of applications. Generally, initially detection and then tracking was mostly done by history of frame based methods. Even though these methods are popular; it has their own limitations. A history of previous frames is needed to be maintained for the conventional tracking methods. This transforms the system to complex for holding the frames and doing manipulations each time.

Differencing the frames [6] and Detection of edges by algorithm [7] finds the differences between the two sequential frames based on the edge's information. On the off chance that the distinction brings non-zero qualities, then which is viewed as in motion. In any case, it suffers a few restrictions that while catching the flow because of the development in environment or any other source might cause the unsettling influence in the situation of the acquisition device coming about into the bogus recognition of the stationary articles [7].

Distinguishing and Following of Multiple Moving Objects for Intelligent Video Surveillance System [8]. RGB Background Modeling technique is proposed with another affectability boundary and is utilized to extricate the moving areas. To take out the commotion, morphology plans are utilized and Directional mass naming is utilized for gathering the moving articles. At last, a channel is utilized to follow different objects from outline to-outline. In any case, that

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technique centers around finding the headings of gathering of moving targets. This method also needs a lot of data related to past frames to store.
Foundation subtraction strategy utilizing Mixture of Gaussian technique [8] is led for discovery of moving article at outside conditions. In this, detection of moving object is done by employing the MoG method for background subtraction process with less computation time. This approach is simple and has more practical aspects. This requires more storage to have previous frames. So past methods are defeated by the optical flow.
Audit of Optical Flow Technique for Moving Object Detection is talked about in [9]. Applying optical stream to an edge of a video gives stream vectors of the focuses comparing to the moving targets. Next denoting the necessary moving object of intrigue checks to post handling. Post handling is the real commitment of the paper for moving article identification issue. This is talked about as Blob Analysis. In the conventional method, velocity vectors of all the points are obtained from that tracking is done. But in modified approach, the highest correlation velocity vectors are obtained and then followed by tracking. It is tried on datasets accessible on the web, ongoing recordings and furthermore on recordings recorded physically. The outcomes show that the moving articles are effectively identified utilizing optical stream method and the necessary post handling.

2. RELATED WORK

In 1981, optical flow based algorithms were proposed in the introductory phase were proposed, now considered as classics: one by Horn and Schunck [10] and the other by Lucas and Canade [11]. Following Horn's definition, the development field is the 2D projection of the 3D development of surfaces on the planet, however the optical stream is the clear development of the wonder structures in the image. On the other hand, the Lucas-Canade approach acknowledge that the stream is essentially steady in a close by neighborhood of the pixel practical, and handles the principal optical stream conditions for all the pixels here, by the least square's premise. A wide scope of optical stream estimations have been made since 1981, including growth and changes of the Horn-Schunk and Lucas-Canade approaches.

In 2000, Christmas [12] presented a separating necessity for the calculation of angle based optical stream. Likewise, various creators suggested the utilization of a separating strategy, for example, Fleet and Langley [13] and Xiao et al. [14]. By and large, the creators utilized one sifting technique in the assessment of optical stream. In [15] the author proposed Gaussian filter as a preprocessing step for optical flow object detection.

For many applications, various parameters like speed, velocity and path of the moving target is needed. If any such history is not found then the accuracy of object detection goes poor. This issue can be solved in optical flow method of tracking. Vehicle Detection and Tracking Based on Optical Field [10]. Horn-Schunck strategy took a shot at optical field to recognize the vehicles. Without knowing any foundation data, this technique can definitely process the video in a constant, selecting the insights of the moving vehicle and tally them. The calculation utilized in the exposition can accomplish the objective of vehicle ID and following, ascertaining and show vehicle stream exactly and maintain a strategic distance from the impedance of people on foot and other superfluous components but it is arrived at higher computation time.

According to [11], joining the calculation of incomplete subordinate in Lucas Canade calculation [16] with blurring and periods of cycle boundary in Schunck unquestionably improve the division and the optical stream. By sifting, the calculation time diminishes and brings about a superior optical stream. The fit boundary to speak to every one of the calculations is finished up dependent on the components which are division, movement vector

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of the movement, and the calculation time. In [23] spatio differentiation strategy for deciding the pay speed by the multi-goal picture of various leveled structure and applied it to find traffic Obstacles. Trial results show that it is conceivable to ascertain speed appropriation in circumstance where objects of different speeds exist and to find traffic impediments. Though a conventional algorithm with slight added features as blob, filters and boundary boxes are used [17] by following single objects using velocity components is practically feasible. But the method is not suitable for on time applications. Initially the modified algorithm is tested in [18], with single objects and the extension of the work is done.

Various moving articles location and global positioning framework is performed by utilizing these procedures in the caught video. In many promising applications the constant moving item identification and following by optical stream technique is truly productive area. Perceiving the development of an article in a video is a difficult assignment because of numerous boundaries like development of an item, change looking like an article, camera movement, commotion and so on. Because of this, it draws considerations of a few specialists, foundations and business associations. To build up a hearty framework with continuous moving item discovery, order and following capacities is our fundamental motivation in examining this issue. The fundamental destinations of this method are the initial stage and advancement of this line following system. Here, in this particular method, we presented the conventional Lucas canade and its modified version. This is inspired from as done same as in Horn Schunk algorithm [24].

As this framework is actualized in a secluded manner with a bit by bit approach, it is anything but difficult to assess a specific calculation's relevance for the framework basically by subbing one sub module for another. This permits regard for be centered around structure plan as opposed to on complexities inside each sub module. In the wake of applying optical stream estimation for recognizing movement flow objects, the vector magnitude boundary is utilized by fragment targets beyond the background. In the modified algorithm, modification is applied to find the highest correlation vectors from the frames so that tracking can be done faster with faster moving objects. Sifting measure eliminates the spot clamor lastly mass investigation is utilized to recognize the objectives for the following cycle. This paper is composed as follows. Area IV communicates the Conventional Lucas canade. Area V talks about an adjusted Lucas canade. In Section VI the test results are introduced. At long last, end is attracted Section VII.

3. RELATED WORK

The importance of item development is utilizing parameter light flow. [19] Light stream assumes a significant job in evaluating the movement of the articles from a grouping of pictures. Fundamentally, optical stream is a speed field of the picture created from the change of one picture into the following picture in a succession [10].

3.1 The Initial Condition

The light stream can't processed in a particular pixel in the picture freely in neighboring focuses in absence presenting extra requirements, in light of the fact that the speed field at each picture point has two segments while the adjustment in picture brilliance at a point in the picture plane because of movement yields just a single limitation. [19] Assumption made by the vast majority of the optical stream technique is that the intensity 'A' of moving focuses is consistent over some stretch of time. This is referred to as intensity constancy assumption as given in equation (4).

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3.2 Smoothness Condition

It is of little any expectation in reconstructing the speeds if each purpose of brightness setup in motion in free [11]. In the obscure objects of the limited size experiencing inflexible movement or distortion, neighboring points on the items have comparable speeds and speed field of the brightness patterns in the picture fluctuates easily all over the place. This outcome in discontinuities in the stream where one items blocks another. A calculation dependent on a perfection condition is probably going to experience issues with blocking edges thus. One approach to represent the extra limitation as in Eq. (1). is therby limit the magnitude square change of the light factor stream speed.

$$\left(\frac{\partial x}{\partial i}\right)^2+\left(\frac{\partial x}{\partial j}\right)^2 \text{ and } \left(\frac{\partial y}{\partial i}\right)^2+\left(\frac{\partial y}{\partial j}\right)^2 \quad (1)$$

Another proportion of the perfection of the light stream field is the aggregate of Laplacians square of the coordinate segments the stream. The Laplacians of coordinates are characterized as Eq. (2).

$$\Delta^2 u=\left(\frac{\partial x}{\partial i}\right)^2+\left(\frac{\partial x}{\partial j}\right)^2 \text{ and } \Delta^2 v=\left(\frac{\partial y}{\partial i}\right)^2+\left(\frac{\partial y}{\partial j}\right)^2 \quad (2)$$

3.3 The Tracking Methodology

The proposed figuring is presented here. Before any movement a frame should be browsed a static camera. Our test films are browsed standard CCTV accounts. Some pre-dealing with assignments must be cultivated for setting up the casing to measure [20]. As a result of the camera's auto white equality and the effect of sudden condition power changes, the mean of each packaging is resolved on diminish scale gathering. The optical stream assessment is the essential bit of the figuring which is executed immediately. Separating spot, drive and general outer clamors instigated because of climate conditions. It is one of the most huge portion in the technique. Middle channel is utilized in our system. During separating action, a couple of openings are made in the edges. To fill these holes and forestall ID bungles morphological action, a couple of holes are made in the edges. To fill these openings and forestall identification botches morphological activity, a few gaps are made in the casings. To fill these gaps and forestall location botches morphological shutting is actualized. Presently the movement objects are identified, however huge numbers of them are not intrigued. Mass investigation causes us to catch objects. Bouncing boxes around the moving objects are the last fragments of the Figure 1.

4. CONVENTIONAL OPTICAL FLOW

Based upon the theory of optical flow, the accuracy of tracking can be improved by finding the velocity vectors of the motion pixels. This modification highlights this conventional method. Here, (Figure 1) moving item identification and following is taken care of by the well-known PC vision methods called an optical stream. The global positioning framework works in indoor and open-air situations with better accuracy by utilizing this procedure. The optical stream determines the movement between two picture frames which are taken at various time

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stretches in the video. The optical stream depicts the path and time pixels in ensuing casings. The movement vector gives precise movement estimation of an item in the progressive frames of the recordings. The caught video outlines are separated by utilizing median filtering technique. The median filter removes the noise component added during capturing and processing. This makes the proposed framework strong within the sight of unwanted noise. It additionally raises the efficiency of tracker. For each edge, do morphological close and erosion tasks. Items with less important are to be evacuated with erosion operators and wanted objects which are moving ought to be closed in boundary. For this expansion activity is utilized to include pixels in the limit. The light parameter vectors of stream are as in Eq. (3). set aside as perplexing numbers and procedure their expand squares which will later be utilized for thresholding.

$$E = \iint (A_i x + A_j y + A_k)^2 d_i d_j + \alpha \iint \left\{ \left(\frac{\partial x}{\partial i}\right)^2 + \left(\frac{\partial x}{\partial j}\right)^2 + \left(\frac{\partial y}{\partial i}\right)^2 + \left(\frac{\partial y}{\partial j}\right)^2 \right\} d_i d_j \quad (3)$$

$$A\, x_i + A\, y_j + A_k \quad (4)$$

In Eq. (4)., A_i, A_j, A_k are the reality subsidiaries of any frame. x and y represents to stream vectors separate way. This equation is the derivatives of optical flow vectors and α scale the Smoothing parameter of global estimation. E is estimation of light flow parameter.

Then velocity threshold is obtained from the group of velocities in matrix as in Eq. (5). and Eq. (6).

$$x_{i,j}^{m+1} = x_{i,j}^{-m} - \frac{A_i (A_i x_{i,j}^{-m} + A_j y_{i,j}^{-m} + A_k)}{\alpha^2 + A_i^2 + A_j^2} \quad (5)$$

$$y_{i,j}^{m+1} = y_{i,j}^{-m} - \frac{A_j (A_i x_{i,j}^{-m} + A_j y_{i,j}^{-m} + A_k)}{\alpha^2 + A_i^2 + A_j^2} \quad (6)$$

In this equation, $\left(x_{i,j}^{m}, y_{i,j}^{m}\right)$ is an estimate of picture element at a coordinate position(x,y) demonstrates speed, but

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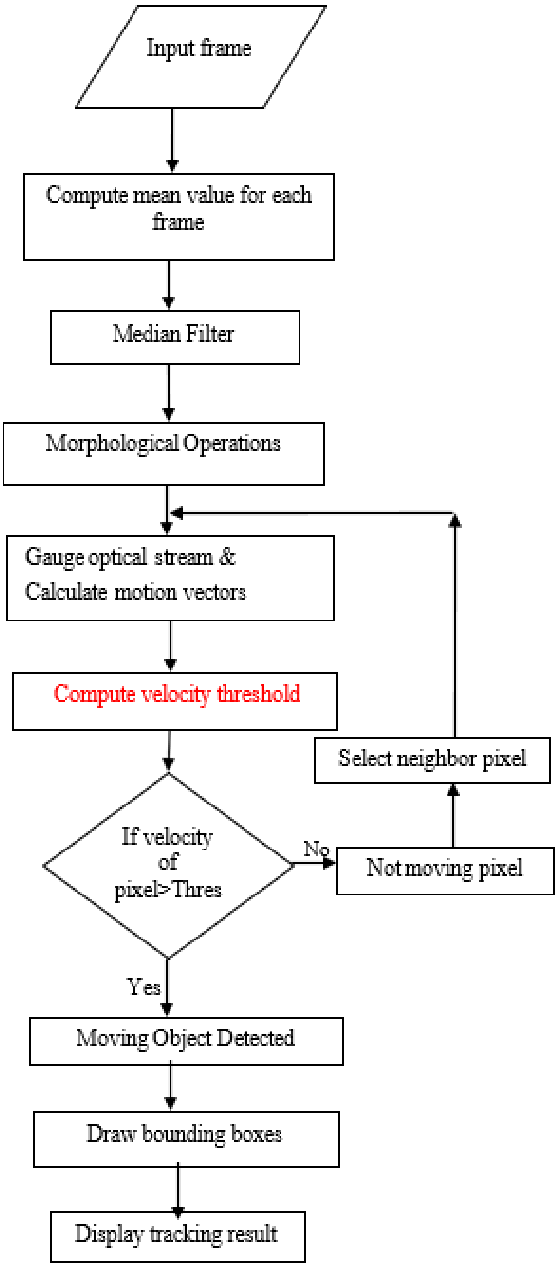

Fig. 1. Conventional Optical Flow

$\left(x_{i,j}^{-m}, y_{i,j}^{-m}\right)$ is the neighbourhood average of $\left(x_{i,j}^{m}, y_{i,j}^{m}\right)$ For m=0, the underlying speed is 0.Next Thinning activity is done to fill the openings in the blobs. Measure the area and box of blob boundary as shown in Eq. (7).

$$Area = (x_{\max} - x_{\min}) * (y_{\max} - y_{\min}) \quad (7)$$

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Draw boxes of limit around the targets which are followed. Compute the movement vectors as in Eq. (8). & Eq. (9). and to figure it.

$$d_x = x' - x = f_x(a, x, y) \qquad (8)$$

$$d_y = y' - y = f_y(b, x, y) \qquad (9)$$

where x,y-area in past picture, x',y'- area in current picture a,b - movement vector coefficient and dx ,dy - displacement. Display tracked frame results.

5. TRACKING WITH MODIFIED LUCAS CANADE

The main modification of the Lucas canade algorithm is represented by the incorporation of the Declare features lost and detect good features processes in the Tracking. This improves the effectiveness of tracking and helps to analyze more about the moving object. Tracking is done till convergence of pixel intensity occurs. The first three steps are the same as in conventional method. The changes in the pixel intensity is scanned in windows [22]. Thus, this method supports tracking in on time videos also. In this method as in [14]using the theory of Eigen vectors the covariance of the pixels are obtained. The pixel having highest Eigen value has high correlation value. This helps in finding out the motion pixels rather than thresholding. The detailed view of the modif ied algorithm in Figure 2 is explained as follows.

Step 1: Picture Acquisition:

It is the way toward getting the picture from any source. The light vitality from the source is seen as force esteem. The image so shaped will be simple in nature. The soul of enthusiasm for this method is light or all the more typically EM waves. In this procedure, a light from the source converges on particular pixel from which some portion of light is reflected back by the object and remaining was absorbed. This is analog in nature.

Step 2: Computation of spatial and temporal derivative

This has to be converted to digital by sampling and quantization process. Thus sampling gives spatial derivative and quantization yields temporal derivative value. The edge pixel has to be identified. For this, Sobel operator can be used.

Sobel Operator is not kidding to find the proportion of the divergence by finding the inclination organize over each pixel of our image and proceed with the powers of a specific edge. As the center segment of cover administrator is incorporate zeros so it doesn't contain the rough assessments of edge in the image yet rather it count the difference of above and underneath pixel forces of the specific edge. As such increasing the unforeseen deviation in their powers as given in making the edge more observable.

Step 3: Least square method

By utilizing sobel edge revelation the spatial and transient subordinates are processed. After finding the subsidiaries, optic stream vectors with the parts u and v for every vicinity are figured by using Least squares technique and its conditions are

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$$,\begin{bmatrix} \sum I_x * I_x & \sum I_x * I_y \\ \sum I_x * I_y & \sum I_y * I_y \end{bmatrix}^{-1} \begin{bmatrix} \sum I_x * I_t \\ \sum I_y * I_t \end{bmatrix} \quad (9)$$

$$\min \sum_t (f_{xt} + f_{yt} + f_t)^2 \quad (10)$$

To handle the u and v this satisfies these conditions Eq. (9). furthermore, Eq. (10) as taking the misstep of pixels and square to restrict the square screw up called least square fit.

Step 4. Circle over edges and highlights

The strategy is considered for a solitary pixel (using its enveloping window) in two consistent picture edges and it is wrapping as in sync 2 for circles, over casings in the course of action and over scanty (deficient pixels) in the edge.

Step 5. Interpolate

After total first accentuation, x and y can be floats; same for u and v and could basically change in accordance with nearest number before enlisting.In any case, results are more exact on the off chance that we interject.

Two types of interpolation are in practice. They are linear interpolation and bilinear interpolation. Bilinear interpolations simply compute double weighted average of four nearest pixels. Be careful to handle boundaries correctly.

Step 6. Declare features lost

In the event that include appearance changes excessively, it has likely floated onto another (blocking) surface in the scene, at that point check the buildup by figuring Sum of square contrasts of highlight window in both I line and J sections.

Stage 7. Recognize great features

Lucas-Canade could be used to figure the development for every pixel in the picture. In any case, movement of close by pixels is comparative. Pixel movement can't be figured in territories of next to zero surface. In this way, first identify great highlights (pixel windows), at that point track just those highlights. Good features can be obtained by solving this condition, $Z= A^TA$ must be invertible. In real world, all matrices are invertible. Instead, ensure that $Z=A^TA$ is well-conditioned not close to singular. In other words, scan image. Evaluate “cornerness” measure at each pixel and perform non-maximal suppression and thereby detect good features.

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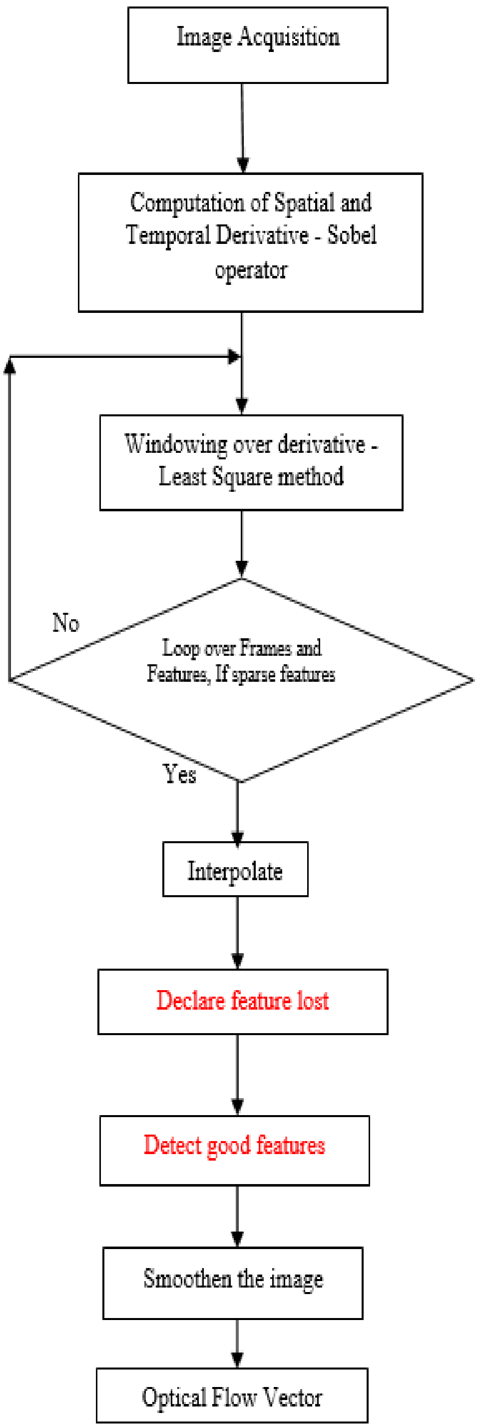

Fig. 2. Modified Lucas Canade

Step 8. Smooth the picture to deal with enormous movements

On the off chance that Motion between back to back picture frames can be huge, at that point smooth the picture first. Smoothing is as of now in gradient calculation, so simply utilize huge s. Be that as it may, huge s prompts less exactness. For this, consecutively diminishes pyramid

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makes this computationally productive. Review scalar condition by linearizing capacity about current estimate as shown in Eq. (11).

$$\begin{bmatrix} I_x & I_y \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} \approx -I_t + \text{upper terms} \qquad (11)$$

Absolute disloging that we need (u). Reconsider:

$$\begin{bmatrix} I_x & I_y \end{bmatrix} \begin{bmatrix} u_\Delta \\ v_\Delta \end{bmatrix} \approx -I_t + \text{upper terms} \qquad (12)$$

Step by step increase in displacement that we compute ($u\Delta$) as shown in Eq. (12).

It is the first iteration of Newton's method. So repeat the steps and accumulate

$$u = u_0 + u_\Delta^1 + u_\Delta^2 + u_\Delta^3 + ...$$

First determinate could be zero

Tracking for one dimension Lucas canade :

For one dimension:

$$I_x u_\Delta = -I_t$$

$$I_x = \frac{rise}{run} = \frac{-I_t}{u_\Delta}$$

First iteration:

1. Given two pictures and position x as appeared in Figure 3.
2. Compute temporal derivative.
3. Compute spatial derivative.
4. Determine step by step increase in x and y as in Figure
5. Rotate I(x) to its right by u_Δ or shift J(x) to the left to the u_Δ as shown in Figure 5 and Figure 6.

In all the Figures 3,4,5,6,7 the x axis represents spatial derivative and y axis represents temporal derivative.

Two Dimension Lucas canade in a nutshell:

$$\begin{bmatrix} I_x & I_y \end{bmatrix} \begin{bmatrix} u_\Delta \\ v_\Delta \end{bmatrix} = -I_t$$

solve for $u_\Delta = (u_\Delta, v_\Delta)$

Given two consecutive images I and J from the sequence Take pixel wise difference between them. It

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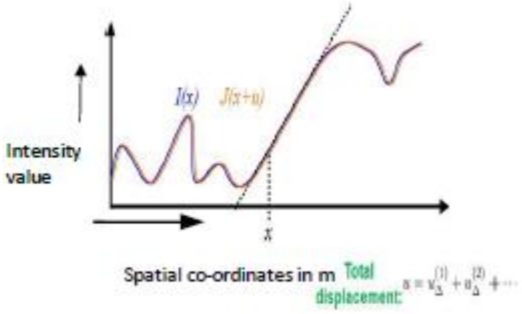

Fig. 3. Given two Images and position

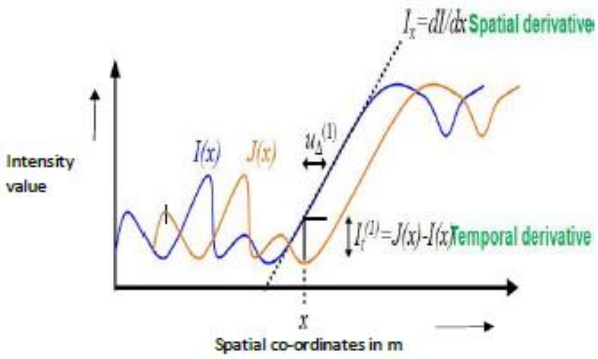

Fig. 4. Computation of Incremental Displacement

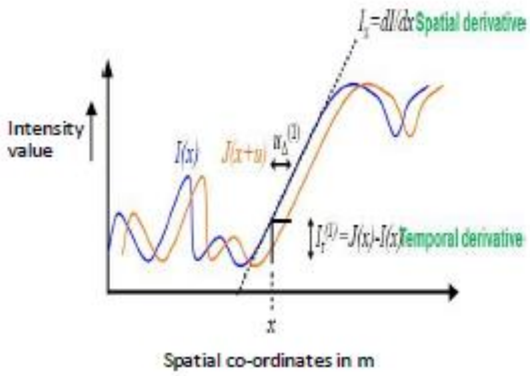

Fig. 5. Shift I(x) by u_Δ to the right

Perform the same iteration:

The procedure has to be performed again and again till convergence as shown in Figure 7. Then determine gradient of one image I_x and I_y [21].

1. To obtain best feature value Z and error value Sum over window .
2. Solve Z u_Δ = e for $u_{\Delta.}$
3. Update u= u^1 + ...
4. Shift image.

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Repeat the steps

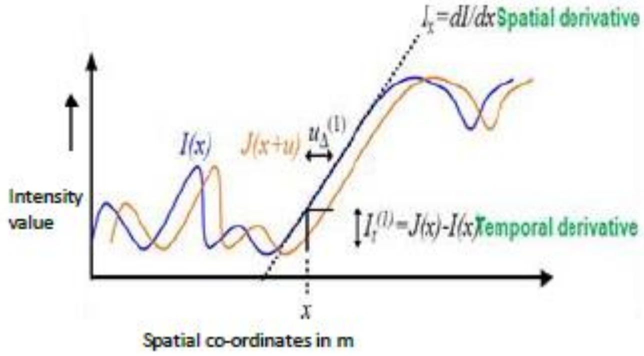

Fig. 6. Shift J(x) by *u* to the left

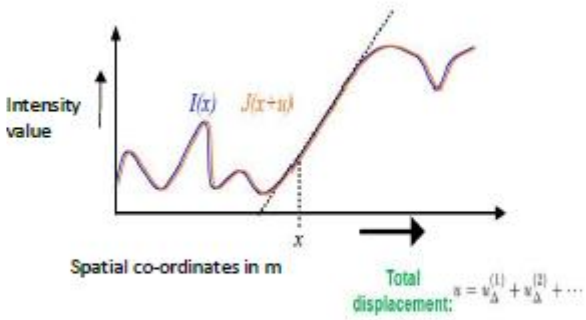

Fig.7. Convergence of Frames

6. EXPERIMENTAL RESULTS

In this segment we show the trial results utilizing standard datasets from traffic shut circuit TV (CCTV) to assess our framework. To show the proficiency of the proposed adjustment, reenactment results are introduced against its ground truth. Determination of the PC used to experience this analysis is Intel Core 2 Duo 3.16 GHz with 4.0 GB RAM.

Results show about single and multiple object tracking with conventional optical flow as in(Fig 8 and 9) and with improved Lucas canade algorithm (Fig 10 and 11).The results are shown by comparing with the ground truth images [22] and [23].The results of I algorithm are better and the tracked output are shown in rectangular boxes. Algorithm I fail to track the real time videos. The computation time of the algorithm is also greatly reduced in algorithm II as shown in table I. Also, algorithm II supports real time videos for tracking. The additional details of the moving object displacement, velocity, speed and direction can also be obtained from algorithm II. Displacement, velocity vector values and speed are obtained for each frame. The direction can be obtained based on the positive and negative values of the speed values. The forward direction is recognized by the positive values and the backward direction is recognized by the negative values. This proposed method also determines the velocity and displacements of frames. Speed, velocity, displacement is calculated by algorithm II using the formula as following.

Direction:

Direction can be evaluated by considering the values of velocity and displacement.

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1. The positive values shows the object moves in forward direction.

2.The negative values shows the object moves in backward direction.

Computation cost:

It represents the processing time of detecting the objects. It is given in ms. It is given in ms.

6.1. Conventional Optical Flow:

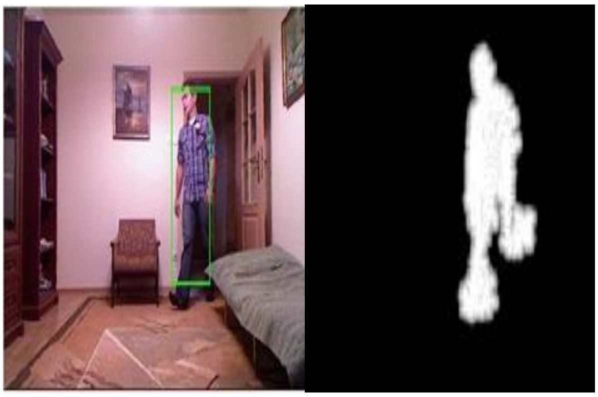
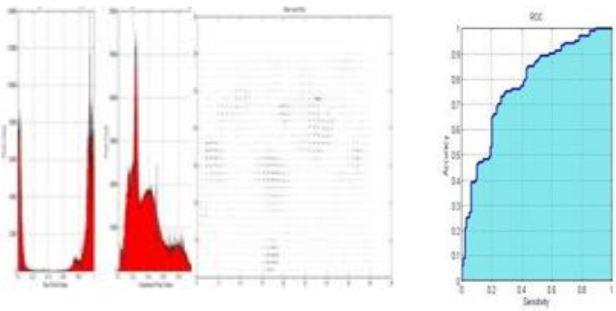


Fig. 8. Tracked output for single object and the corresponding ground truth



8a. Histogram of Hue, Saturation & Value	8b.Motion Vector Field	8c.ROC

The State of Art method for tracking is its ground truth. Figure 8 and Figure 9 represents tracking result for single and multiple objects respectively. Figure a represents the hue, saturation and value of the colors in the given image in histogram. From that the color information is helpful in determining the threshold value. Figure b. represents the motion vector field which was obtained by optical flow vectors. Figure c. represents the ROC with Sensitivity and accuracy in x and y axis.

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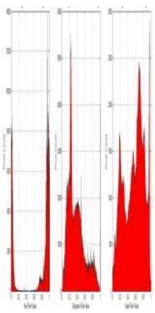
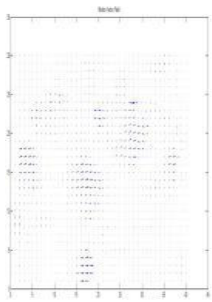
For Multiple Objects:

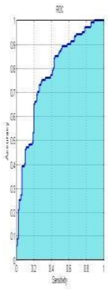
Fig. 9. Tracked output for multiple object and the corresponding ground truth



9a. Histogram of Hue, Saturation and Value



MotionVector Field



9c.ROC

Figure a represents the hue, saturation and value of the colors in the given image in histogram. From that the color information is helpful in determining the threshold value. Figure b represents the motion vector field which was obtained by optical flow vectors. Figure c represents the ROC with Sensitivity and accuracy in x and y axis.

6.2.Modified Lucas canade algorithm:

Fig. 10. Tracked output for single object and the corresponding Ground Truth

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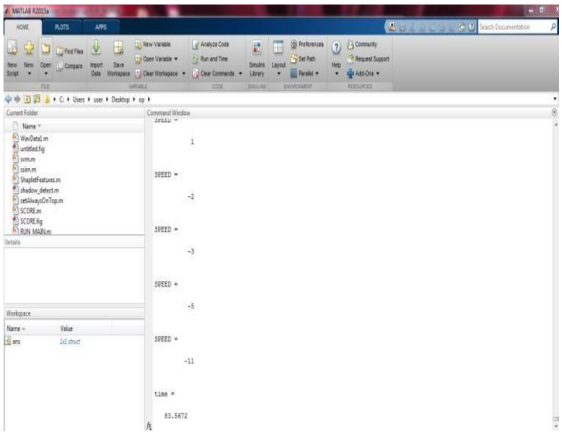

Fig. 11. Speed and Computational time for single man moving for 96 frames

Fig. 12. Tracked output for multiple object and the corresponding Ground Truth

Figure 10 and 12 shows the tracked output for single and multiple moving objects for improved Lucas canade algorithm along with its ground truth.

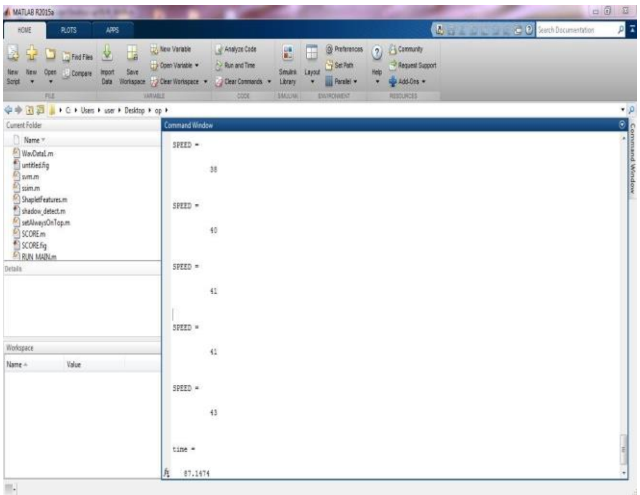

Fig. 13: Speed and Computational time for multiple tigers moving for 116 frames

Figure 11 and 13 represent the speed and computation time for the respective online videos.

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Table 1. Computation Time for Algorithm I and Algorithm II

Methods	**Average Computation Time in ms**	
	Single Object for 96 frames	**Multiple Object for 116 frames**
Conventional Optical Flow	86.9174	214.6742
Optical Flow with Improved Lucas Canade	0.167	0.183

Table 1 depicts the average processing times (in ms) of proposed framework when applied on RGB (720×1280) fig.8, RGB (288×352) fig.9 , RGB (240×300) fig.10, RGB

(360×640) fig.12 image format and the frame rate were 24 frame/sec.

Thus the above Table 1 gives result of two algorithms which shows algorithm II has reduced computation cost compare to algorithm I. This is because method II is done without thresholding. In this method, the moving object is identified by highest Eigen value which represents the covariance value. This is done in best feature declare step in the procedure.

Table 2. Comparison of ComputationTime for Traditional methods [27] and Proposed Algorithm (Algorithm II)

Methods	**ms/Frame**
Detection of motion	16.0
Adaptive Optical Flow with no window	20.8
Adaptive Optical Flow with 1x3 window	20.8
Lucas-Kanade olderversion	33.6
Horn-Schunck	30.2
Block Matching	192.0
Optical Flow with Modified Lucas Canade	1.670

Table 2 gives the computation time for various traditional methods and in the improved Lucas Canade algorithm. The results of various methods are directly obtained from [27]. Compared to these methods, this improved lucas canade method proves to have low computation cost.

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In the Table 3, the Displacement, velocity and direction of the moving object for single object of a man dataset is given. The forward and backward movement is obtained from the positive and negative values of velocity

Table 3. Velocity and Displacement for some Frames

Displacement in m	**Velocity in m/ms**	**Direction**
0.0374	-0.0055	Forward
-0.0402	0.0070	Forward
-0.0212	-0.0013	Backward
0.0596	-0.0140	Forward
-0.0526	0.0067	Forward
-0.0269	-0.0037	Backward
-0.0931	0.0239	Forward
0.0496	-0.0057	Forward

Table 4: Speed Value for Some Frames

Frame Number	**Speed in (m/sec)**
72	72
92	78
98	94
102	139
114	141

The speed values are obtained in Table 4, for tiger moving dataset and the values are representing for the first tiger among the many tigers. Similarly, the speed values of other moving objects can also be obtained.

7. CONCLUSIONS

Optical flow means of tracking objects is robust for various challenging environments. The main drawback of optical flow algorithm is its high computation cost which is very clear from the literature. The conventional algorithm proves its goodness by initially tested with single moving object and later with multiple moving objects. This algorithm gives better tracking result with low computation time.The goodness of the modified lucas canade algorithm can be viewed from the binary or ground truth results and also from performance comparison between various methods in literature. Detailed information of the moving object such as displacement, velocity, speed and direction can be obtained from algorithm II. This algorithm works well for real time videos from static camera. The same algorithm can be tested for moving camera videos and under various challenging environments.

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